MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING

Siruseri IT park, OMR, Chennai - 603103

LESSON PLAN

Department of Electrical and Electronics Engineering

Name of the Subject	ELECTRICAL MACHINES-I	Name of the handling Faculty	Dr.Jeha.J
Subject Code	EE3303	Year / Sem	II/III
Academic Year	2022-23	Batch	2021-25

Course Objective

To impart knowledge on the following Topics

Concept of electromechanical energy conversion system

Identify the appropriate machine for a given application based on its characteristics

Identify the appropriate test to determine the performance parameters of a given machine

Familiarize with the procedure for parallel operation of generators and transformers

Deliberate the working of autotransformer and three phase transformers

Course Outcome

Upon Completion of the course, the students will be able to

CO1: Apply the laws governing the electromechanical energy conversion for singly and multiple excited systems

CO2: Explain the construction and working principle of DC machines

CO3: Interpret various characteristics of DC machines

CO4: Compute various performance parameters of the machine by conducting suitable tests

CO5: Draw the equivalent circuit of transformer and predetermine the efficiency and regulation

CO6:Describe the working principle of autotransformer ,three phase transformer with different types of connections

Lesson Plan

Sl. No.	Topic(s)	T / R* Book	Periods Required	Mode of Teaching (BB / PPT / NPTEL / MOOC / etc)	Blooms Level (L1-L6)	CO	PO
UNIT I ELECTROMECHANICAL ENERGY CONVERSION							
1	Fundamentals of Magnetic circuits	T1,T2,R1	1	BB,PPT	L1	CO1	PO1-PO5
2	Statically and dynamically induced emf	T1,T2,R1	1	BB,PPT	L2	CO1	PO1-PO5
3	Principle of electromechanical energy conversion	T1,T2,R1	1	BB,PPT	L3	CO1	PO1-PO5
4	Forces and torque in magnetic field systems	T1,T2,R1	1	BB,PPT	L2	CO1	PO1-PO5
5	Energy balance in magnetic circuits	T1,T2,R1	1	BB,PPT	L4	CO1	PO1-PO5
6	Magnetic force,coenergy in singly and multi excited magnetic field system	T1,T2,R1	1	BB,PPT	L3	CO1	PO1-PO5
7	mmf of distributed windings	T1,T2,R1	1	BB,PPT	L2	CO1	PO1-PO5
8	Winding Inductances.	T1,T2,R1	1	BB,PPT	L2	CO1	PO1-PO5
9	magnetic fields in rotating machines	T1,T2,R1	1	BB,PPT	L3	CO1	PO1-PO5
10	magnetic saturation and leakage fluxes	T1,T2,R1	1	BB,PPT	L3	CO1	PO1-PO5

11	Introduction to Indian Standard Specifications	T1,T2,R1	1	BB,PPT	L3	CO1	PO1-PO5
12	Role and significance in testing	T1,T2,R1	1	BB,PPT	L3	CO1	PO1-PO5

Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any
Assignment on Properties of Magnetic Material

Evaluation method : Quiz on Electromechanical energy conversion

UNIT II DC GENERATORS

13	Constructional details	T1,T2,R1	1	BB,PPT	L2	CO2	PO1-PO5
14	principle of operation	T1,T2,R1	1	BB,PPT	L3	CO2	PO1-PO5
15	armature windings and its types	T1,T2,R1	1	BB,PPT	L3	CO2	PO1-PO5
16	EMF equation	T1,T2,R1	1	BB,PPT	L3	CO2	PO1-PO5
17	wave shape of induced emf	T1,T2,R1	1	BB,PPT	L3	CO2	PO1-PO5
18	armature reaction	T1,T2,R1	1	BB,PPT	L3	CO2	PO1-PO5
19	demagnetising and cross magnetising ampere turns	T1,T2,R1	1	BB,PPT	L4	CO2	PO1-PO5
20	compensating winding,applications of DC generators	T1,T2,R1	1	BB,PPT	L3	CO2	PO1-PO5
21	commutation,methods of improving commutation	T1,T2,R1	1	BB,PPT	L4	CO2	PO1-PO5
22	interpoles,equalizing connections	T1,T2,R1	1	BB,PPT	L4	CO2	PO1-PO5
23	OCC and load characteristics of different types of DC generators	T1,T2,R1	1	BB,PPT	L3	CO3	PO1-PO5
24	Parallel operation of DC generators	T1,T2,R1	1	BB,PPT	L3	CO3	PO1-PO5

Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any
Assignment - Problems based on efficiency,regulation.

Evaluation method Quiz on DC generators

UNIT III DC MOTORS

25	Principle of operation	T1,T2,R1	1	BB,PPT	L1	CO2	PO1-PO5
26	Significance of back emf	T1,T2,R1	1	BB,PPT	L2	CO2	PO1-PO5
27	Torque and power developed by armature	T1,T2,R1	1	BB,PPT	L3	CO2	PO1-PO5
28	Speed control of DC motors	T1,T2,R1	1	BB,PPT	L3	CO2	PO1-PO5
29	Starting methods of DC motors	T1,T2,R1	1	BB,PPT	L3	CO2	PO1-PO5
30	Load characteristics of DC motors	T1,T2,R1	1	BB,PPT	L3	CO3	PO1-PO5
31	Losses and efficiency in DC machine	T1,T2,R1	1	BB,PPT	L2	CO3	PO1-PO5
32	Condition for maximum efficiency	T1,T2,R1	1	BB,PPT	L3	CO3	PO1-PO5
33	Brake test,Swinburne's test	T1,T2,R1	1	BB,PPT	L3	CO4	PO1-PO5

34	Hopkinson's test,Field test	T1,T2,R1	1	BB,PPT	L2	CO4	PO1-PO5
35	Retardation test,applications of DC motors	T1,T2,R1	1	BB,PPT	L3	CO4	PO1-PO5
36	Separation of core losses	T1,T2,R1	1	BB,PPT	L3	CO4	PO1-PO5

Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any
Assignment on Retardation test

Evaluation method
Quiz on DC motors

UNIT IV SINGLE PHASE TRANSFORMER

37	Construction and principle of operation	T1,T2,R1	1	BB,PPT	L2	CO5	PO1-PO5
38	Equivalent circuit,phasor diagram	T1,T2,R1	1	BB,PPT	L2	CO5	PO1-PO5
39	Testing - polarity test	T1,T2,R1	1	BB,PPT	L3	CO5	PO1-PO5
40	Open circuit and short circuit tests	T1,T2,R1	1	BB,PPT	L4	CO5	PO1-PO5
41	voltage regulation	T1,T2,R1	1	BB,PPT	L4	CO5	PO1-PO5
42	losses and efficiency	T1,T2,R1	1	BB,PPT	L3	CO5	PO1-PO5
43	All day efficiency,back to back test	T1,T2,R1	1	BB,PPT	L3	CO5	PO1-PO5
44	Separation of core losses	T1,T2,R1	1	BB,PPT	L3	CO5	PO1-PO5
45	Parallel operation of single phase transformers	T1,T2,R1	1	BB,PPT	L3	CO5	PO1-PO5
46	Applications of single phase transformers	T1,T2,R1	1	BB,PPT	L2	CO5	PO1-PO5
47	Problems	T1,T2,R1	1	BB,PPT	L3	CO5	PO1-PO5
48	Problems	T1,T2,R1	1	BB,PPT	L3	CO5	PO1-PO5

Suggested Activity: Assignment / Case Studies / Tutorials/ Quiz / Mini Projects / Model Developed/others Planned if any : Assignment: Problems based on losses,efficiency,regulation

Evaluation method : Quiz on single phase transformers

UNIT V AUTO TRANSFORMER AND THREE PHASE TRANSFORMER

49	Construction and working of auto transformer	T1,T2,R4	1	BB,PPT	L2	CO6	PO1-PO5
50	Comparison with two winding transformers	T1,T2,R4	1	BB,PPT	L2	CO6	PO1-PO5
51	Applications of autotransformer	T1,T2,R4	1	BB,PPT	L2	CO6	PO1-PO5
52	Three phase transformers construction	T1,T2,R4	1	BB,PPT	L2	CO6	PO1-PO5
53	Types of connections	T1,T2,R4	1	BB,PPT	L2	CO6	PO1-PO5
54	Comparative features	T1,T2,R5	1	BB,PPT	L3	CO6	PO1-PO5
55	Scott connection	T1,T2,R6	1	BB,PPT	L4	CO6	PO1-PO5

56	Applications of Scott connection	T1,T2,R7	1	BB,PPT	L3	CO6	PO1-PO5
57	Problems- Tutorials	T1,T2,R8	1	BB,PPT	L3	CO6	PO1-PO5
58	Problems- Tutorials	T1,T2,R8	1	BB,PPT	L3	CO6	PO1-PO5
59	Problems- Tutorials	T1,T2,R8	1	BB,PPT	L3	CO6	PO1-PO5
60	Problems- Tutorials	T1,T2,R9	1	BB,PPT	L3	CO6	PO1-PO5

Suggested Activity: Assignment / Case Studies / Tutorials/ Quiz / Mini Projects / Model Developed/others Planned if any : Experiments will be done through connection mode for swinburne's test and hopkinson's test.

Evaluation method: connection based circuit

Content Beyond the Syllabus Planned

1	Electric field optimization of high voltage electrode based on neural network
2	Protection of transmission systems by using the global positioning system

Text Books

1	Nagrath, I.J. and Kothari.D.P., Electric Machines, McGraw-Hill Education, 2017
2	P S Bimbhra,Electric Machinery,Khanna Publishers,2021

Reference Books

1	A E Fitzgerald and C Kingsley,Electric Machinery,New York,Mcgraw Hill Education,2017
2	A E Clayton and N N Hancock,Performance and design of DC machines,CBS Publishers,2018
3	M G Say,Performance and design of AC machines,CBS publishers,2008
4	Sahdev S K ,Electrical Machines,Cambridge University Press,2018

Website / URL References

1	https://nptel.ac.in/courses/108/106/108106071/
2	https://nptel.ac.in/courses/108/105/108105155/
3	https://nptel.ac.in/courses/108/105/108105017/

Blooms Level

Level 1 (L1) : Remembering **Level 2 (L2) : Understanding** **Level 3 (L3) : Applying**	Lower Order Thinking	Fixed Hour Exams	Level 4 (L4) : Analysing Level 5 (L5) : Evaluating Level 6 (L6) : Creating		Higher Order Thinking	Projects / Mini Projects

Mapping syllabus with Bloom's Taxonomy LOT and HOT

Unit No	Unit Name	L1	L2	L3	L4	L5	L6	LOT	HOT	Total
Unit 1	ELECTROMECHANICAL ENERGY CONVERSION AND CONCEPTS	1	4	6	1	0	0	11	1	12
Unit 2	DC GENERATORS	0	1	8	3	0	0	9	3	12
Unit 3	DC MOTORS	1	3	8	0	0	0	12	0	12
Unit 4	SINGLE PHASE TRANSFORMERS	0	2	7	3	0	0	9	3	12
Unit 5	THREE PHASE TRANSFORMERS	0	5	4	3	0	0	9	3	12
Total		2	15	33	10	0	0	50	10	60

Total Percentage						3.33	25.00	55.00	16.67	0.00	0.00	83.33	16.67	100.00

CO PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1	1								3	3
CO2	3	3	1	1	1								3	3
CO3	3	3	1	1	1								3	3
CO4	3	3	1	1	1								3	3
CO5	3	3	1	1	1								3	3
CO6	3	3	1	1	1								3	3
Avg	**3**	**3**	**1**	**1**	**1**								3	3

Justification for CO-PO mapping

CO1	High correlation for PO1, PO2 and medium correlation for PO3,PO4,PO5 and its related with PSO2 can be used to apply knowledge of engineering to identify , formulate and provide solutions
CO2	High correlation for PO1,PO2 and medium correlation for PO3 ,PO4,PO5 and its related with PSO2 it is having life long learning in the field of DC machines
CO3	High correlation for PO1, PO2 and its related with PSO2 it is having application in DC machines
CO4	High correlation for PO1, PO2 and its related with PSO2 can be used to apply knowledge of engineering to identify , formulate and provide solutions by using relevant techniques and tools
CO5	High correlation for PO1, PO2 and medium level correlation for PO3,PO4,PO5 and its related with PSO1 it is applicable in single phase transformers
CO6	High correlation for PO1, PO2 and medium level correlation for PO3,PO4,PO5 and its related with PSO2 it is applicable in three phase and auto transform

1	**High level**	**3**	Moderate level	1	Low level

Name & Sign of Faculty Incharge : Dr.Jeha.J

Name & Sign of Subject Expert : Dr.Kamalaselvan.A

Head of the Department : Dr.Jeha.J

Format No :231